

forward portions of each of the inner shaft **40** and the outer shaft **50**. The first aft bearing assembly **74** is supported at a point along the inner shaft **40** forward of the connection **80** between the low pressure turbine rotor **78** and the inner shaft **40**.

[0071] Positioning of the first aft bearing **74** forward of the connection **80** can be utilized to reduce the overall length of the engine **20**. Moreover, positioning of the first aft bearing assembly **74** forward of the connection **80** provides for support through the mid turbine frame **58** to the static structure **36**. Furthermore, in this example the second aft bearing assembly **76** is deployed in a straddle mount configuration aft of the connection **84** between the outer shaft **50** and the rotor **82**. Accordingly, in this example, both the first and second aft bearing assemblies **74**, **76** share a common support structure to the static outer structure **36**. As appreciated, such a common support feature provides for a less complex engine construction along with reducing the overall length of the engine. Moreover, the reduction or required support structures will reduce overall weight to provide a further improvement in aircraft fuel burn efficiency.

[0072] Referring to FIG. **10**, a portion of the example turbine section **28** is shown and includes the low pressure turbine **46** and the high pressure turbine **54** with the mid turbine frame **58** disposed between an outlet of the high pressure turbine and the low pressure turbine. The mid turbine frame **58** and vane **60** are positioned to be upstream of the first stage **98** of the low pressure turbine **46**. While a single vane **60** is illustrated, it should be understood these would be plural vanes **60** spaced circumferentially. The vane **60** redirects the flow downstream of the high pressure turbine **54** as it approaches the first stage **98** of the low pressure turbine **46**. As can be appreciated, it is desirable to improve efficiency to have flow between the high pressure turbine **54** and the low pressure turbine **46** redirected by the vane **60** such that the flow of expanding gases is aligned as desired when entering the low pressure turbine **46**. Therefore vane **60** may be an actual airfoil with camber and turning, that aligns the airflow as desired into the low pressure turbine **46**.

[0073] By incorporating a true air-turning vane **60** into the mid turbine frame **58**, rather than a streamlined strut and a stator vane row after the strut, the overall length and volume of the combined turbine sections **46**, **54** is reduced because the vane **60** serves several functions including streamlining the mid turbine frame **58**, protecting any static structure and any oil tubes servicing a bearing assembly from exposure to heat, and turning the flow entering the low pressure turbine **46** such that it enters the rotating airfoil **100** at a desired flow angle. Further, by incorporating these features together, the overall assembly and arrangement of the turbine section **28** is reduced in volume.

[0074] The above features achieve a more or less compact turbine section volume relative to the prior art including both high and low pressure turbines **54**, **46**. Moreover, in one example, the materials for forming the low pressure turbine **46** can be improved to provide for a reduced volume. Such materials may include, for example, materials with increased thermal and mechanical capabilities to accommodate potentially increased stresses induced by operating the low pressure turbine **46** at the increased speed. Furthermore, the elevated speeds and increased operating temperatures at the entrance to the low pressure turbine **46** enables the low pressure turbine **46** to transfer a greater amount of energy, more efficiently to drive both a larger diameter fan **42** through the

geared architecture **48** and an increase in compressor work performed by the low pressure compressor **44**.

[0075] Alternatively, lower priced materials can be utilized in combination with cooling features that compensate for increased temperatures within the low pressure turbine **46**. In three exemplary embodiments a first rotating blade **100** of the low pressure turbine **46** can be a directionally solidified casting blade, a single crystal casting blade or a hollow, internally cooled blade. The improved material and thermal properties of the example turbine blade material provide for operation at increased temperatures and speeds, that in turn provide increased efficiencies at each stage that thereby provide for use of a reduced number of low pressure turbine stages. The reduced number of low pressure turbine stages in turn provide for an overall turbine volume that is reduced, and that accommodates desired increases in low pressure turbine speed.

[0076] The reduced stages and reduced volume provide improve engine efficiency and aircraft fuel burn because overall weight is less. In addition, as there are fewer blade rows, there are: fewer leakage paths at the tips of the blades; fewer leakage paths at the inner air seals of vanes; and reduced losses through the rotor stages.

[0077] The example disclosed compact turbine section includes a power density, which may be defined as thrust in pounds force (lbf) produced divided by the volume of the entire turbine section **28**. The volume of the turbine section **28** may be defined by an inlet **102** of a first turbine vane **104** in the high pressure turbine **54** to the exit **106** of the last rotating airfoil **108** in the low pressure turbine **46**, and may be expressed in cubic inches. The static thrust at the engine's flat rated Sea Level Takeoff condition divided by a turbine section volume is defined as power density and a greater power density may be desirable for reduced engine weight. The sea level take-off flat-rated static thrust may be defined in pounds-force (lbf), while the volume may be the volume from the annular inlet **102** of the first turbine vane **104** in the high pressure turbine **54** to the annular exit **106** of the downstream end of the last airfoil **108** in the low pressure turbine **46**. The maximum thrust may be Sea Level Takeoff Thrust "SLTO thrust" which is commonly defined as the flat-rated static thrust produced by the turbofan at sea-level.

[0078] The volume **V** of the turbine section may be best understood from FIG. **10**. As shown, the mid turbine frame **58** is disposed between the high pressure turbine **54**, and the low pressure turbine **46**. The volume **V** is illustrated by a dashed line, and extends from an inner periphery **I** to an outer periphery **O**. The inner periphery is defined by the flow path of rotors, but also by an inner platform flow paths of vanes. The outer periphery is defined by the stator vanes and outer air seal structures along the flowpath. The volume extends from a most upstream end of the vane **104**, typically its leading edge, and to the most downstream edge of the last rotating airfoil **108** in the low pressure turbine section **46**. Typically this will be the trailing edge of the airfoil **108**.

[0079] The power density in the disclosed gas turbine engine is much higher than in the prior art. Eight exemplary engines are shown below which incorporate turbine sections and overall engine drive systems and architectures as set forth in this application, and can be found in Table I as follows: